

REMARKS

Entry of the foregoing, re-examination and reconsideration of the subject matter identified in caption, as amended, pursuant to and consistent with 37 C.F.R. §1.112, and in light of the remarks which follow, are respectfully requested.

Claims 4-10, 13-16 and 64 have been cancelled, claims 1-3, 11, 17-19, 59-63, 65-72, 74-76, 78-80, 85, 87-90, 95, 97-100, 105 and 106 have been amended and new claims 108-110 have been added. Support for the changes in claim 11 may be found on page 15, lines 17-19 (K_2O of 1-5 molar %) and on page 16, lines 8-10 (TiO_2 of 2-9 molar %). Support for new claims 108 and 109 may be found in paragraphs [0070] and [0071] on pages 27-28 of the specification. New claim 110 is identical to claim 60 except for dependency on claim 108. Amendments to the other claims were made to change claim dependencies.

In response to the Examiner's objections to the specification, a new Abstract has been provided and the Summary of the Invention, paragraph [0012], has been revised to eliminate reference to claims. Accordingly, the objections to the specification have been obviated.

Claims 1-3 and 66-69 have been rejected under 35 U.S.C. §112, second paragraph, for reasons set forth on page 3 of the Office Action. In response thereto, claims 1-3 have been amended to depend upon claims 11, 108 and 109, respectively. Also, the word "substantial" has been removed from claims 66-69 to expedite prosecution. Those of ordinary skill in this art would understand that "substantial" amounts are those which would affect the properties desired in the glasses of the invention. Amounts present as

impurities or in amounts which do not affect the desired properties are not excluded. In view of the above amendments, the §112 rejection should be withdrawn.

In response to the objection to claims 61 and 65 set forth on page 3-4 of the Office Action, the dependencies of these claims has been changed. Accordingly, the objection has been obviated.

Claims 1-19, 59-101, 105 and 106 have been rejected under 35 U.S.C. §102(e) as anticipated by U.S. Patent 6,333,282 to Nakahata et al. for the reasons given on pages 4-5 of the Office Action. Reconsideration of this rejection is requested in view of the above amendments and the following remarks.

Independent claims 11, 108 and 109 are directed to optical glasses which include, inter alia, specific amounts of K_2O and TiO_2 . Thus, the glasses of claim 11 require 1-5% of K_2O and 2-9% of TiO_2 while the glasses of claims 108 and 109 require 0.5-7% of K_2O and 1-9% TiO_2 . TiO_2 is incorporated in order to improve the resistance of the glass to loss of transparency (see [0029] page 16). However, since incorporation of TiO_2 makes glass colored, the glasses of the present invention contain an amount of K_2O sufficient to avoid coloring with TiO_2 .

In contrast, the glasses taught by Nakahata '282 do not contain TiO_2 and K_2O . As a matter of fact, the reference teaches away from adding TiO_2 . Note the discussion in column 6, lines 40-64. Thus, Nakahata '282 is not anticipatory. In view thereof, the §102(e) rejection should be withdrawn.

From the foregoing, further and favorable action in the form of a Notice of Allowance is believed to be next in order and such action is earnestly solicited. If the Examiner has any questions concerning this paper or the application in general, she is invited to telephone the undersigned at (703) 838-6683.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: George F. Lesmes
George F. Lesmes
Registration No. 19,995

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

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MARK-UP COPY OF THE ABSTRACT

An optical glass having a high refractive index and high dispersion characteristics [that is suited to] suitable for application to precision press molding to precisely mold [the shape of] final products [for objectives not] without requiring grinding or polishing. An optical glass can be prepared exhibiting a refractive index in the range of from 1.75 to 2.0, and an Abbé number in the range of from 20 to 28.5. Optical parts comprised of this glass; press-molding materials comprised of this glass; methods of manufacturing the same; and methods of manufacturing molded glass products employing these materials. A suitable optical glass is composed of the following in molar percent: 15-30% P_2O_5 ; 0.5-15% B_2O_3 ; 5-25% Nb_2O_5 ; 6-40% WO_3 ; 4-45% of at least one of Li_2O , Na_2O or K_2O ; 1-5% K_2O ; 2-9% TiO_2 ; and 0-30% (excluding 30%) of at least one RO selected from among BaO , ZnO , and SrO ; with the total content of the above-stated components being equal to or more than 95 percent.

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Paragraph [0012]

Summary of the Invention

That is, the present invention provides:

1. An optical glass (referred to hereinafter as optical glass (1)) exhibiting a refractive index in the range of from 1.75 to 2.0, an Abbé number in the range of from 20 to 28.5, and a viscosity at the liquid phase temperature equal to or higher than 0.4 Pa·s.
2. An optical glass (referred to hereinafter as optical glass (2)) exhibiting a refractive index in the range of from 1.75 to 2.0, an Abbé number in the range of from 20 to 28.5, and a glass transition temperature equal to or less than 540°C.
3. An optical glass (referred to hereinafter as optical glass (3)) exhibiting a refractive index in the range of from 1.75 to 2.0, an Abbé number in the range of from 20 to 28.5, and a transmittance λ_{80} is equal to or less than 500nm and a transmittance λ_5 is equal to or less than 385nm.
4. The optical glass of any of [claims] 1-3 above wherein said optical glass comprising, as molar percentages, 12-34 percent of P_2O_5 ; 0.2-15 percent of B_2O_3 ; 0-25 percent of Nb_2O_5 ; 0-40 percent of WO_3 ; 4-45 percent of at least one R'_2O selected from among Li_2O , Na_2O , and K_2O ; and 0-30 percent (excluding 30 percent) of at least one RO selected from among BaO, ZnO, and SrO; with the total content of the above-stated components being equal to or more than 94 percent.

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5. The optical glass of any of [claims] 1-3 above wherein said optical glass comprising, as molar percentages, 12-34 percent of P_2O_5 ; 0.2-15 percent of B_2O_3 (where the total quantity of P_2O_5 and B_2O_3 is 15-35 percent); 0-45 percent of WO_3 ; 0-25 percent of Nb_2O_5 ; 0 to 10 percent of TiO_2 (where the total quantity of WO_3 , Nb_2O_5 , and TiO_2 is 20-45 percent); 0-25 percent of BaO ; 0-20 percent of ZnO (where the total quantity of BaO and ZnO is less than 30 percent); 2-30 percent of Li_2O ; 2-30 percent of Na_2O ; 0-15 percent of K_2O (where the total quantity of Li_2O , Na_2O , and K_2O is 10-45 percent); 0-10 percent of CaO ; 0-10 percent of SrO ; 0-5 percent of Al_2O_3 ; 0-5 percent of Y_2O_3 ; 0-1 percent of Sb_2O_3 ; and 0-1 percent of As_2O_3 ; where the total quantity of all of the above-listed components is equal to or more than 94 percent.

6. An optical glass comprising, as molar percentages, 15-30 mol percent of P_2O_5 ; 0.5-15 mol percent of B_2O_3 ; 5-25 mol percent of Nb_2O_5 ; 6-40 mol percent of WO_3 ; 4-45 mol percent of at least one R'_2O selected from among Li_2O , Na_2O , and K_2O ; and 0-30 percent (excluding 30 percent) of at least one RO selected from among BaO , ZnO , and SrO ; with the total content of the above-stated components being equal to or more than 95 percent.

7. An optical glass (referred to hereinafter as optical glass (4)) comprising 15-30 percent of P_2O_5 ; 0.5-15 percent of B_2O_3 ; 5-25 percent of Nb_2O_5 ; 6-40 percent of WO_3 ; 4-45 percent of at least one R'_2O selected from among Li_2O , Na_2O , and K_2O ; and 0-30 percent (excluding 30 percent) of at least one RO selected from among BaO , ZnO , and SrO ; with the total content of the above-stated components being equal to or more than 95 percent.

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8. The optical glass of [claim] 7 above wherein said optical glass comprising 0-25 molar percent (excluding 0 molar percent) of BaO.

9. An optical glass (referred to hereinafter as optical glass (5)) comprising 15-30 percent of P₂O₅; 0.5-15 percent of B₂O₃; 5-25 percent of Nb₂O₅; 6-40 percent of WO₃; not more than 10 percent of TiO₂; 4-45 percent of at least one R'₂O selected from among Li₂O, Na₂O, and K₂O; and 0-30 percent (excluding 30 percent) of at least one RO selected from among BaO, ZnO, and SrO.

10. An optical glass (referred to hereinafter as optical glass (6)) comprising, as molar percentages, 12-34 percent of P₂O₅; 0.2-15 percent of B₂O₃ (where the total quantity of P₂O₅ and B₂O₃ is 15-35 percent); 0-45 percent of WO₃; 0-25 percent of Nb₂O₅; 0 to 10 percent of TiO₂ (where the total quantity of WO₃, Nb₂O₅, and TiO₂ is 20-45 percent); 0-25 percent of BaO; 0-20 percent of ZnO (where the total quantity of BaO and ZnO is less than 30 percent); 2-30 percent of Li₂O; 2-30 percent of Na₂O; 0-15 percent of K₂O (where the total quantity of Li₂O, Na₂O, and K₂O is 10-45 percent); 0-10 percent of CaO; 0-10 percent of SrO; 0-5 percent of Al₂O₃; 0-5 percent of Y₂O₃; 0-1 percent of Sb₂O₃; and 0-1 percent of As₂O₃; where the total quantity of all of the above-listed components is equal to or more than 94 percent; a density of oxygen atoms contained is in the range of from 4.2×10^{22} to $5.2 \times 10^{22}/\text{cm}^3$.

11. An optical glass (referred to hereinafter as optical glass (7)) comprising, as molar percentages, 12-34 percent of P₂O₅; 0.2-15 percent of B₂O₃ (where the total quantity of P₂O₅ and B₂O₃ is 15-35 percent); 2-45 percent of WO₃; 0-25 percent of Nb₂O₅; 0 to 10 percent of TiO₂ (where the total quantity of WO₃, Nb₂O₅, and TiO₂ is 20-45 percent); 0-25 percent of

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BaO; 0-20 percent of ZnO (where the total quantity of BaO and ZnO is less than 30 percent); 2-30 percent of Li₂O; 2-30 percent of Na₂O; 0-15 percent of K₂O (where the total quantity of Li₂O, Na₂O, and K₂O is 29-45 percent); 0-10 percent of CaO; 0-10 percent of SrO; 0-5 percent of Al₂O₃; 0-5 percent of Y₂O₃; 0-1 percent of Sb₂O₃; and 0-1 percent of As₂O₃; where the total quantity of all of the above-listed components is equal to or more than 94 percent.

12. An optical glass (referred to hereinafter as optical glass (8)) comprising, as molar percentages, 12-34 percent of P₂O₅; 0.2-15 percent of B₂O₃ (where the total quantity of P₂O₅ and B₂O₃ is 15-35 percent); 2-45 percent of WO₃; 0-25 percent of Nb₂O₅; 0 to 10 percent of TiO₂ (where the total quantity of WO₃, Nb₂O₅, and TiO₂ is 20-45 percent); 0-11 percent of BaO; 0-20 percent of ZnO (where the total quantity of BaO and ZnO is less than 30 percent); 2-30 percent of Li₂O; 2-30 percent of Na₂O; 0-15 percent of K₂O (where the total quantity of Li₂O, Na₂O, and K₂O is 10-45 percent); 0-10 percent of CaO; 0-10 percent of SrO; 0-5 percent of Al₂O₃; 0-5 percent of Y₂O₃; 0-1 percent of Sb₂O₃; and 0-1 percent of As₂O₃; where the total quantity of all of the above-listed components is equal to or more than 94 percent.

13. The optical glass of any of [claims] 10-12 above wherein said optical glass has the composition comprising, as essential components, P₂O₅, B₂O₃, WO₃, Nb₂O₅, TiO₂, BaO, ZnO, Li₂O, Na₂O and K₂O or the composition comprising the above essential components and Sb₂O₃.

14. The optical glass of [claims] 10 or 11 above wherein said optical glass comprises 0-11 percent of BaO.

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15. The optical glass of [claims] 10 or 12 above wherein said total quantity of Li_2O , Na_2O , and K_2O is equal to or more than 29 percent.
16. The optical glass of any of [claims] 10 to 12 above wherein said optical glass has a density of oxygen atoms contained in the range of from 4.2×10^{22} to $5.2 \times 10^{22}/\text{cm}^3$.
17. An optical glass (referred to hereinafter as optical glass (9)) comprising P_2O_5 , B_2O_3 , WO_3 and an alkali metal oxide, wherein the total quantity of P_2O_5 and B_2O_3 is 15-35 molar percent and a content of WO_3 is 2-45 molar percent and a density of oxygen atoms contained ranges from 4.2×10^{22} to $5.2 \times 10^{22}/\text{cm}$.
18. The optical glass of [claims] 17 above wherein said optical glass comprises 2-30 molar percent of Li_2O .
19. The optical glass of any of [claims] 10-18 above wherein said optical glass does not comprise substantial amount of GeO_2 .
20. The optical glass of any of [claims] 10-19 above wherein said optical glass exhibits a glass transition temperature equal to and/or less than 530°C and a yield point temperature equal to or less than 580°C .
21. The optical glass of any of [claims] 10-20 above wherein said optical glass exhibits a refractive index in the range of from 1.7 to 2.0, an Abbé number in the range of from 20 to 32.
22. The optical glass of any of [claims] 10-20 above wherein said optical glass exhibits a liquid phase temperature equal to or less than 970°C .
23. An optical part being composed of the optical glass of any of [claims] 1-22 above.

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24. A glass preform being composed of the optical glass of any of [claims] 1-22 above.

25. A method of manufacturing glass preforms wherein a prescribed amount of a piece of molten glass flowing out of a flowout pipe is received in a receiving mold to prepare a glass preform made of the optical glass of any of [claims] 1-22 above.

26. A method of manufacturing glass preforms made of the optical glass of any of [claims] 1-22 above, comprising the steps of :

a molten glass glob is made to fall by causing molten glass flowing out of a flowout pipe to drip naturally or by cutting with a cutting blade;

the molten glass glob is received in a depression in a forming mold, and in the process, air, a nonreactive gas or some other gas is blown out through minute holes in the depressions; and,

a layer of air is generated between the molten glass glob and the inner surface of depression in the forming mold and the molten glass glob is maintained and cooled within the depression in a state of essential non-contact with the inner surface of the depression until at least a portion of the outer surface of the molten glass glob reaches a temperature not greater than the melting temperature.

27. A method of manufacturing glass products comprising the steps of :

heating the glass preform of [claim] 24 above or the glass preform prepared by the method of [claim] 25 above and
precisely press molding the heated glass preform to obtain a glass product.

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Marked-Up Copy of Claims

1. (Amended) [An] The optical glass of claim 11 exhibiting a refractive index in the range of from 1.75 to 2.0, an Abbé number in the range of from 20 to 28.5, and a viscosity at a liquid phase temperature equal to or higher than 0.4 Pa·s.
2. (Amended) [An] The optical glass of claim 108 exhibiting a refractive index in the range of from 1.75 to 2.0, an Abbé number in the range of from 20 to 28.5, and a glass transition temperature equal to or less than 540°C.
3. (Amended) [An] The optical glass of claim 109 exhibiting a refractive index in the range of from 1.75 to 2.0, an Abbé number in the range of from 20 to 28.5, and a transmittance λ 80 is equal to or less than 500nm and a transmittance λ 5 is equal to or less than 385 nm.
11. (Amended) An optical glass comprising as molar percentages, 15-30 percent of P₂O₅; 0.5-15 percent of B₂O₃; 5-25 percent of Nb₂O₅; 6-40 percent of WO₃; 4-45 percent of at least one R'₂O selected from [among] the group consisting of Li₂O, Na₂O, and K₂O, 1-5 percent of K₂O; [and] 0-30 percent (excluding 30 percent) of at least one RO selected from [among] the group consisting of BaO, ZnO, and SrO; and 2-9 percent of TiO₂; with the total content of the above-stated components being equal to or more than 95 percent.

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17. (Amended) The optical glass of claim [14] 11 wherein said optical glass has the composition comprising, as essential components, P_2O_5 , B_2O_3 , WO_3 , Nb_2O_5 , TiO_2 , BaO , ZnO , Li_2O , Na_2O and K_2O or the composition comprising the above essential components and Sb_2O_3 .

18. (Amended) The optical glass of claim [15] 108 wherein said optical glass has the composition comprising, as essential components, P_2O_5 , B_2O_3 , WO_3 , Nb_2O_5 , TiO_2 , BaO , ZnO , Li_2O , Na_2O and K_2O or the composition comprising the above essential components and Sb_2O_3 .

19. (Amended) The optical glass of claim [16] 109 wherein said optical glass has the composition comprising, as essential components, P_2O_5 , B_2O_3 , WO_3 , Nb_2O_5 , TiO_2 , BaO , ZnO , Li_2O , Na_2O and K_2O or the composition comprising the above essential components and Sb_2O_3 .

59. (Amended) The optical glass of claim [14] 11 wherein said optical glass comprises 0-11 percent of BaO .

60. (Amended) The optical glass of claim [14] 11 wherein said total quantity of Li_2O , Na_2O , and K_2O is equal to or more than 29 percent.

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61. (Amended) The optical glass of claim [14] 11, wherein said optical glass has a density of oxygen atoms contained in the range of from 4.2×10^{22} to $5.2 \times 10^{22}/\text{cm}^3$.

62. (Amended) The optical glass of claim [15] 108 wherein said optical glass has a density of oxygen atoms contained in the range of from 4.2×10^{22} to $5.2 \times 10^{22}/\text{cm}^3$.

63. (Amended) The optical glass of claim [16] 109 wherein said optical glass has a density of oxygen atoms contained in the range of from 4.2×10^{22} to $5.2 \times 10^{22}/\text{cm}^3$.

65. (Amended) The optical glass of claim [62] 11 wherein said optical glass comprises 2-30 molar percent of Li_2O .

66. (Amended) The optical glass of claim [14] 11 wherein said optical glass does not comprise [substantial] an amount of GeO_2 .

67. (Amended) The optical glass of claim [15] 108 wherein said optical glass does not comprise [substantial] an amount of GeO_2 .

68. (Amended) The optical glass of claim [16] 109 wherein said optical glass does not comprise [substantial] an amount of GeO_2 .

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69. (Amended) The optical glass of claim 62 wherein said optical glass does not comprise [substantial] an amount of GeO_2 .

70. (Amended) The optical glass of claim [14] 11 wherein said optical glass exhibits a glass transition temperature equal to and/or less than 530°C and a yield point temperature equal to or less than 580°C .

71. (Amended) The optical glass of claim [15] 108 wherein said optical glass exhibits a glass transition temperature equal to and/or less than 530°C and a yield point temperature equal to or less than 580°C .

72. (Amended) The optical glass of claim [16] 109 wherein said optical glass exhibits a glass transition temperature equal to and/or less than 530°C and a yield point temperature equal to or less than 580°C .

74. (Amended) The optical glass of claim [14] 11 wherein said optical glass exhibits a refractive index in the range of from 1.7 to 2.0, an Abbé number in the range of from 20 to 32.

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75. (Amended) The optical glass of claim [15] 108 wherein said optical glass exhibits a refractive index in the range of from 1.7 to 2.0, an Abbé number in the range of from 20 to 32.

76. (Amended) The optical glass of claim [16] 109 wherein said optical glass exhibits a refractive index in the range of from 1.7 to 2.0, an Abbé number in the range of from 20 to 32.

78. (Amended) The optical glass of claim [14] 11 wherein said optical glass exhibits a liquid phase temperature equal to or less than 970°C.

79. (Amended) The optical glass of claim [15] 108 wherein said optical glass exhibits a liquid phase temperature equal to or less than 970°C.

80. (Amended) The optical glass of claim [16] 109 wherein said optical glass exhibits a liquid phase temperature equal to or less than 970°C.

85. (Amended) An optical part being composed of the optical glass of claim [10] 12.

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87. (Amended) An optical part being composed of the optical glass of claim [13]
17.
88. (Amended) An optical part being composed of the optical glass of claim [14]
60.
89. (Amended) An optical part being composed of the optical glass of claim [15]
108.
90. (Amended) An optical part being composed of the optical glass of claim [16]
109.
95. (Amended) A glass preform being composed of the optical glass of claim [10]
12.
97. (Amended) A glass preform being composed of the optical glass of claim [13]
17.
98. (Amended) A glass preform being composed of the optical glass of claim [14]
60.

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99. (Amended) A glass preform being composed of the optical glass of claim [15] 108.

100. (Amended) A glass preform being composed of the optical glass of claim [16] 109.

105. (Amended) The optical glass of claim [16] 108 wherein said optical glass comprises 0-11 percent of BaO.

106. (Amended) The optical glass of claim [16] 109 wherein said total quantity of Li_2O , Na_2O , and K_2O is equal to or more than 29 percent.